

Acne and diet – there is a link

NEIL MANN BAppSci, BSci(Hons), DipEd, PhD, RNutr

A recent study challenges the current medical paradigm that diet and acne are not linked. The study concluded that acne is nutritionally related through a mechanism involving insulin resistance, and hypothesised that lowering hyperinsulinaemia through dietary modification (by changing to a higher protein low-glycaemic load diet) may decrease the incidence and severity of acne.

The general belief within the medical community is that there is no link between acne and an individual's diet. This has been based predominantly on two poor-quality US studies from more than 30 years ago. A recent dietary intervention trial challenges this paradigm. The results of the randomised, parallel, controlled study conducted by researchers at the RMIT University, Melbourne, and the Royal Melbourne Hospital were presented at the 15th European Academy of Dermatology and Venereology congress held in Rhodes in 2006, and published in a series of peer-reviewed papers in international nutrition and dermatology journals.¹⁻⁶

In this article, one of the study's authors reviews the beliefs about acne, presents the diet-acne hypothesis supported by the study and discusses the application of the link between insulin resistance, high-glycaemic load (GL) diets and acne in the management of acne.

The pathogenesis of acne

Acne is a common and often psychologically debilitating problem that affects people of any age (Figure 1). In Western countries almost all adolescents experience it at some time, as do 40 to 54% of adults up to 25 years of age.⁷ Not surprisingly, improvements in acne can have significant effects on self-esteem, confidence and overall mood.

The four basic stages of acne pathogenesis are:

- follicular hyperkeratinisation
- an increase in sebum production
- colonisation of the sebaceous glands by *Propionibacterium acnes*
- the resulting cytokine production and inflammatory response of the surrounding tissues.

Acne is a disease of modern societies

The human diet has evolved over an extended time period, but was basically unrefined natural vegetation and meats for several million years. The introduction of refined grain products and starchy vegetables is a relatively new event. Although the incidence of acne is high in modern societies eating such foods, it is almost zero in hunter-gatherer societies whose diet is closer to that of our ancestors. A study published in 2002 did not find any acne in 1300 adolescents in Paraguay and Papua New Guinea, where the diets are



Figure 1. A patient with acne vulgaris on the face.

based on lean meat, fruits and vegetables.⁷ Also, an earlier study showed that acne only emerged in Inuits when they adopted a Western diet.⁸ However, the orthodox paradigm in medicine continues to promote that diet does not cause acne.

Current beliefs about acne

The current belief that acne and diet are not linked is based on two poorly designed studies conducted in 1969 and 1971.^{9,10} Looking back at these studies, they would not have passed peer review in modern times, and hence would not have been published. The authors were dermatologists, and had little knowledge of food composition.

In the first of these studies, published in 1969, Fulton and colleagues gave 30 adolescents attending an acne clinic and 35 young adult male prisoners with acne a chocolate bar or a placebo bar every day for four weeks, and then swapped them to the other bar.⁹ No difference was seen between the groups in terms of acne severity or sebum output. There was, however, no difference in the sugar or fat contents of the two types of bar, hence no real comparison was being performed.

In the second study, by Anderson and published in 1971, 27 college students simply ate large amounts of 'culprit foods' (such as chocolate, nuts and soft drinks) every day for one week.¹⁰ One-third of the subjects exhibited new acne lesions, while

Dr Mann is Professor of Human Nutrition in the School of Applied Sciences, RMIT University, Melbourne, Vic.

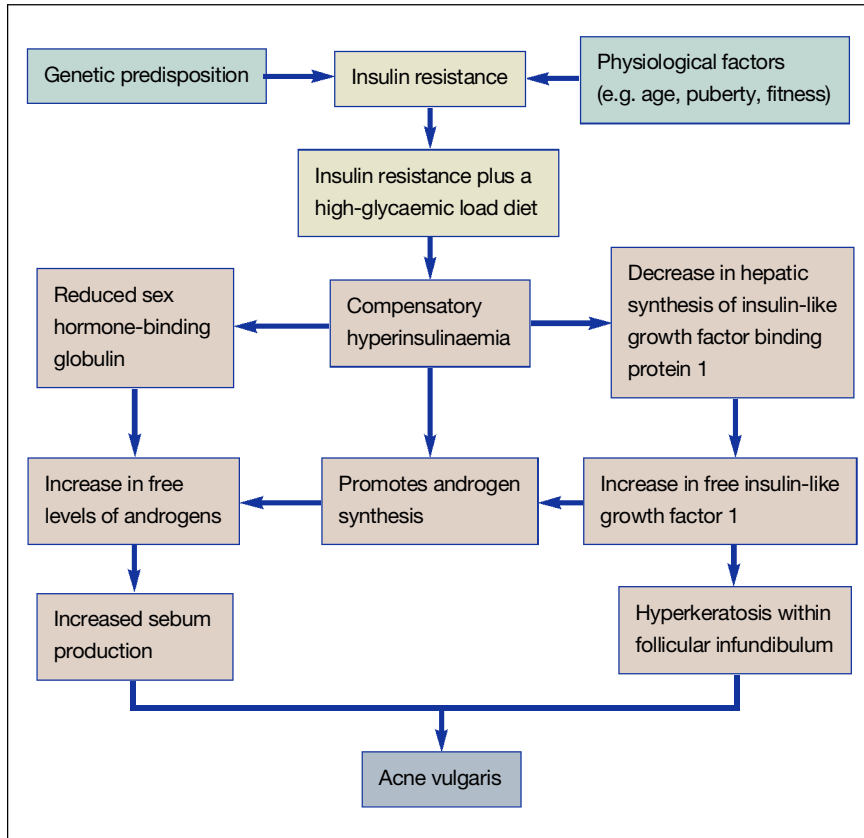


Figure 2. Hypothesised link between diet and acne. A high glycaemic load diet and the compensating hyperinsulinaemia and insulin resistance are hypothesised to trigger hormonal effects that lead to acne. (Adapted from references 1 and 2.)

half had a slight improvement in their acne (a decrease in lesion numbers).

Although these were completely uncontrolled studies with no dietary analysis or methods for acne scoring, they are the basis of current medical school teachings.

The diet and acne hypothesis

From a nutritional standpoint, there is no evidence that any one individual food causes acne, but neither is there one food responsible for any other lifestyle disease. However, there may be several dietary factors that interact to cause or exacerbate acne, possibly based on a mechanism involving insulin resistance.

In primitive societies, insulin resistance aided survival because it reduced the

uptake into muscle cells of the glucose obtained from the little carbohydrate in the diet, allowing this glucose to be used instead for brain function and fetal development. A major part of muscular energy in those societies was obtained from the ingestion of protein and fat.

Nowadays, in modern societies where food is abundant, factors such as stage of life, puberty (when there is a state of temporary insulin resistance), lack of physical activity, and overweight or obesity may increase any residual insulin resistance we still have. This increase may be to levels such that there is no longer a survival benefit but instead possible development of consequences such as polycystic ovary syndrome, metabolic syndrome, acne and, eventually, diabetes.

Therefore, the combination of a high-GL (typically Western) diet with compensating hyperinsulinaemia and insulin resistance is hypothesised to trigger a chain of hormonal effects that lead to acne (Figure 2).

The study

The hypothesis of the recent dietary intervention trial was that, in adolescents, modern high-GL diets (which contain abundant amounts of highly processed high-glycaemic index [GI] starchy and sugary foods) interact with the insulin resistance state that is present temporarily during puberty, leading to the cascade of hormonal and metabolic changes that result in adolescent acne.

The trial compared a low-GL diet similar to our ancestral diet (containing mainly unprocessed foods, such as vegetables, lean meat, fish, whole grains and fruits) with a high-GL diet of modern processed foods. To change from a high-GL diet to a low-GL diet requires a reduction in carbohydrate intake, replacement of high-GI carbohydrates with low-GI alternatives, and an increase in the protein intake to keep energy intake adequate (an increase in fat intake is not an option because of weight gain and blood lipid effects). Increased intakes of lean red meat, fish and poultry replace the energy previously provided by high-GI carbohydrates; increased intakes of legumes provide the energy in vegetarian diets.

In the study, 43 adolescent males aged between 15 and 25 years and with moderate to severe acne were randomised to either continue their high-GL diet (the control group) or change to a higher protein low-GL diet. In the low-GL diet, 25% of energy was derived from protein, 45% from low-GI carbohydrates and 30% from fat. All the participants used the same low-level topical acne facial wash, and their acne was formally measured and assessed by a dermatologist blinded to the dietary group.

Results after 12 weeks are summarised below.

- The total numbers of acne lesions and inflammatory counts were significantly reduced in participants in the low-GL group compared with those in the control group: 52% reduction in total counts in the low-GL group versus 31% reduction in the control group ($p < 0.05$).^{1,2} These figures are similar to those seen in published trials with long-term topical acne therapies.
- Participants in the low GL group had a mean weight loss of 2.9 kg while those in the control group had a mean weight gain of 0.5 kg ($p < 0.01$). This was postulated to be due to the high satiety associated with a higher protein diet and the resultant reduced food intake.^{1,2}
- There was a significant drop in the levels of fasting insulin and total cholesterol in participants in the low-GL group, in comparison to those in the control group. There was a positive association of this with insulin sensitivity as measured by a standard insulin sensitivity index (HOMA-IR). The increased insulin sensitivity (decreased insulin resistance) led to an improvement in acne.^{1,2}
- Compared with participants in the control group, those in the low-GL group had significant reductions in the levels of active male hormones, as measured by the Free Androgen Index (FAI). The correlation between the change in acne lesion counts and bioavailable androgen levels is not surprising because androgenic hormones are known to increase sebum production. This supports the notion that FAI may actually be a marker for acne.

The researchers concluded that acne was related to diet, thus dispelling the myth that there is no link between acne and diet. They hypothesised that lowering hyperinsulinaemia through dietary

modification (increasing intake of both protein-rich foods and low-GI carbohydrates) may decrease the incidence and/or severity of acne. Additional studies are needed to investigate this further, because the unplanned weight loss was a confounder in the study.

Weight loss may be a consequence of this type of dietary approach that is difficult to avoid in free-living subjects. It may, however, be desirable in many cases.

Conclusion

The medical paradigm that diet and acne are not linked is based on two questionable studies published in the USA about 40 years ago. A recent study, however, has suggested that acne and diet are related. The researchers in the study hypothesise that the combination of insulin resistance and a high-GL diet has a role in the development of acne, and that lowering hyperinsulinaemia through dietary modification (by changing to a higher protein low-GL diet) may decrease the incidence and severity of acne.

MT

References

1. Smith NR, Mann NJ, Braue A, Mäkeläinen H, Varigos GA. A low-glycemic-load diet improves symptoms in acne vulgaris patients: a randomized controlled trial. *Am J Clin Nutr* 2007; 86: 107-115.
2. Smith NR, Mann NJ, Braue A, Mäkeläinen H, Varigos GA. The effect of a high-protein, low glycemic-load diet versus a conventional, high glycemic load diet on biochemical parameters associated with acne vulgaris: a randomised, investigator-masked, controlled trial. *J Am Acad Dermatol* 2007; 57: 247-256.
3. Smith R, Mann N. Acne in adolescence: a role for nutrition. *Nutr Diet* 2007; 64 (s4): S1 47-149.
4. Smith R, Mann, NJ, Braue A, Varigos G. Acne and the western diet: a review of the potential pathological mechanisms involved. In: Cohen M, ed. *Integrative medicine perspectives*. (Proceedings of the Australian Integrative Medicine Association's 13th International Holistic Health Conference.) Sydney: AG Publishing; 2007.
5. Smith RN, Braue A, Varigos GA, Mann NJ. The effect of a low glycemic load diet on acne vulgaris and the fatty acid composition of skin surface triglycerides. *J Dermatol Sci* 2008; 50: 41-52.
6. Smith R, Mann N, Mäkeläinen H, Roper J, Braue A, Varigos G. A pilot study to determine the short-term effects of a low glycemic load diet on hormonal markers of acne: a nonrandomized, parallel, controlled feeding trial. *Mol Nutr Food Res* 2008; 52: 718-726.
7. Cordain L, Lindeberg S, Hurtado M, Hill K, Eaton SB, Brand-Miller J. Acne vulgaris: a disease of Western civilization. *Arch Dermatol* 2002; 138: 1584-1590.
8. Schaefer O. When the Eskimo comes to town. *Nutr Today* 1971; 6: 8-16.
9. Fulton JE Jr, Plewig G, Kligman AM. Effect of chocolate on acne vulgaris. *JAMA* 1969; 210: 2071-2074.
10. Anderson PC. Foods as the cause of acne. *Am Fam Physician* 1971; 3: 102-103.

COMPETING INTERESTS: Dr Mann and his co-researchers in the described study received funding for the study from Meat and Livestock Australia.